BALL BROTHERS RESEARCH CORPORATION

NEW TECHNOLOGY REPORT

ENTITLED

"TEMPERATURE COMPENSATED SLEEVE-TYPE MIRROR MOUNT"

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New Technology Report

Temperature Compensated Sleeve-Type Mirror Mount

Brief Description

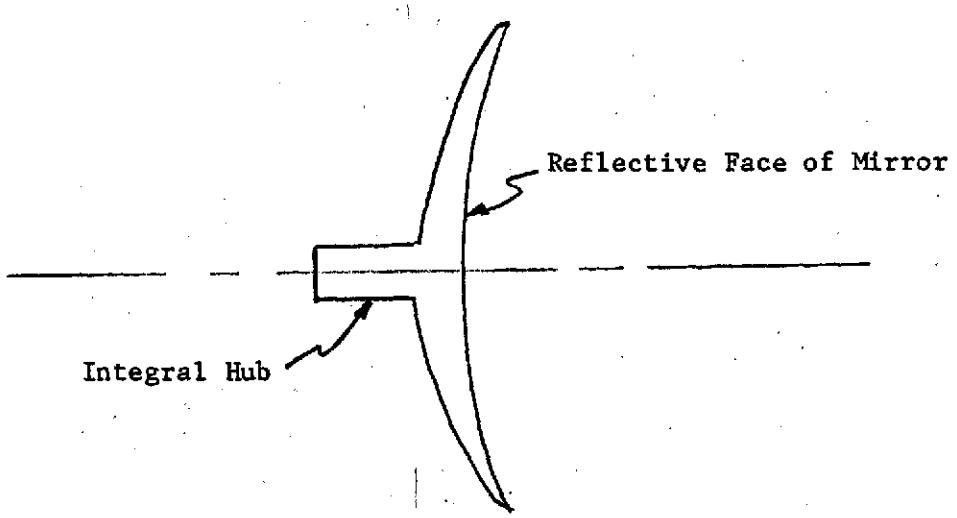
A mirror is mounted by bonding a sleeve around a mounting hub which is integral with the mirror. Our bonding technique permits the temperature coefficients of the sleeve, bonding material and hub to be matched to minimize temperature induced stress in the hub and mirror.

Detailed Description

The primary mirror of a large (26-inch diameter aperture) solar telescope was made of glass ceramic and designed with an integral hub on the back of the center of the mirror. This permits heat from the mirror to radiate off its back to a nearby cold plate.

To permit mounting without high stresses, the hub was ground down to a smooth cylindrical surface 3.5 inch in diameter. The ground surface was then acid-etched to remove 0.007 inch (on the diamter) by immersion for five minutes in a mixture of four parts 92% sulfuric acid and three parts 50% hydrofluoric acid. The acid etching removes microcracks from the ground Cer-Vit surface.

An Invar sleeve was fabricated to fit over the hub with about 0.010 inch radial (0.020 inch diametral) clearance.



The sleeve was bonded in place on the hub using a polyurethane potting compound. The hub and sleeve were held by tooling while the polyurethane cured (several hours at 150°F).

The polyurethane thickness (0.010 inch) was chosen to minimize thermal stress. The thermal stress is zero in the polyurethane if $t = r\frac{\alpha_I}{\alpha_P}$

where: t = Polyurethane thickness

r = Radius of hub

α_I = Temperature coefficient of Invar

α_P = Temperature coefficient of polyurethane

(This assumes the temperature coefficient of Cer-Vit is negligible compared to α_I; if not, $\alpha_I - \alpha_{CV}$ would have been used instead of α_I). Minimizing thermal stress prevents mirror deformation from compressive stress and also prevents breaking of the polyurethane bond under tensile stress.

Selection of polyurethane as the potting material was made on the basis of the following:

- good elongation properties
- high load-bearing capability
- good low-temperature performance
- high damping

The solar telescope with which this mounting system was designed to be used is described further in -

Final Report, CIT Photoheliograph Definition Study, Vol. II
Contract NAS8-30190
MSFC-DRL-212
April 1971.